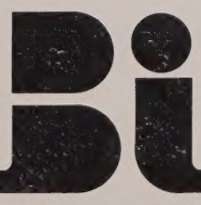
BERKELEY INSTRUMENTS INC.

Model 10 RF-1



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BERKELEY INSTRUMENTS INC.

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BERKELEY INSTRUMENTS INCORPORATED

INSTRUCTION MANUAL

CONTROLLED
DOCUMENT

MODEL-10 RF-1

MAR 2 2 1995

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SECTION 1

1.1 INTRODUCTION

The PSC Model 10RF-1 plug-in module is used to perform RF current gain tests on a great variety of semiconductors at selectable DC operating conditions. A frequency range of 3 MHz to 30 MHz is standard; however, operation up to 60 MHz is typical for most transistors.

1.2 SPECIFICATIONS

1.2.1 General

The 10RF-1 utilizes a common emitter/tuned amplifier to measure the RF forward current gain of the transistor under test. The user must supply a signal generator to excite the amplifier, but all other functions incidental to the measurement such as the attenuator, DC current and voltage supplies, and the RF voltmeter are included in the Model 70/10RF-1 system.

The overall system consists of the Model 70 base unit which contains the primary power sources, the power meter movements, the power controls and the 10RF-1 module, which plugs into the Model 70 base unit. This module contains the DC current and voltage supplies, the switching controls, DC meter range selection and switching, the DC amplifier and BETA meter, and the RF attenuator.

The 10RF-1 module accepts a plug-in test card which carries the transistor test circuit and the detector portion of the RF voltmeter. The exact ranges covered will depend upon the characteristics of the device being tested.

1.2.2 Voltage Supply

Five collector-emitter ranges are selected by a selector switch on the module, along with a variable control on basic unit. Ranges and maximum current available are listed below:

RANGE, VOLTS	MAXIMUM CURRENT
30	1 Amp
10	1 Amp
3	1 Amp
1	1 Amp

1.2.3 Current Supply

Zero to 10 Volts, variable current is supplied by the Model 70 basic unit up to 1 Amp maximum. The current supply is normally used with series resistor to form a constant current source. Series resistors are selected by the current range selector switch for 3, 10, 20, 100, 300 MA, 1 Amp full-scale ranges.

1.2.4 RF Voltmeter

The radio frequency detection function is achieved by means of zero threshold back diodes mounted on the test cards. The low level DC signal from the detector diodes is amplified by the meter amplifier on the main plug-in module. The meter amplifier utilizes a unique solid state temperature control system and multiple feed back loops to achieve a high degree of stability. The amplifier output is displayed by the BETA meter. Full scale BETA ranges are 3, 10, 30, 100. The applicable range is selected by the attenuator setting.

1.2.5 RF Attenuator

The RF attenuator sets the level of the input signal to the test card. The attenuator will provide 0 DB to 30 DB of attenuation in 10 DB increments.

1.2.6 Overload Protection Sensing

An overload circuit in the basic unit is tripped with 1 to 2.5 volts into a 100K load, (standard sensitivity setting - See 5.4.5); sense line floating.

1.2.7 Physical Characteristics

1.2.7.1 Construction: Aluminum alloy chassis, anodized aluminum front panel with three color markings.

1.2.7.2 Dimensions: 8 1/2" wide by 7" high by 13" deep.

1.2.7.3 Weight: Approximately 10 lbs.

1.2.8 Test Card

Band switching over frequency range of 3 MHz to 30 MHz minimum.

1.2.9 Recommended External Equipment

RF Generator 1V RMS output

Hewlett Packard 3200 B
Tektronix Model 190 (50 MHz Maximum)
Marconi TF 1247 (20-300 MC) accessory 50 ohm matching transformer TM 5227 is required.

SECTION 2

OPERATION

2.1 GENERAL

This section contains instructions on the basic unit and module controls only. Test instructions for the RF parameter tests are covered in the Test-Card description.

The module and basic unit controls described following will apply to all Test Cards. The module controls are color-coded and grouped to assist the operator in changing settings and reading test results.

2.2 MODULE CONTROLS

2.2.1 Voltage Range Switch

Selects the voltage ranges of the voltage supply and the high-resistance voltage divider.

2.2.2 Current Range Switch

Selects basic unit upper meter current range and current supply limiting resistor.

2.2.3 Current Range Switch

Selects current range of the module meter.

2.2.4 Polarity Switch

Sets polarity of all supplies, meters, and overload sense line.

2.2.5 Zero Control

Sets zero-scale of RF Voltmeter with no input.

2.2.6 10 DB Switch

Inserts 10 DB of attenuation when set to "10 DB".

2.2.7 20 DB Switch

Inserts 20 DB of attenuation when set to "20 DB".

2.3 BASIC UNIT CONTROLS AND METERS WHEN USED WITH 10 RF-1

2.3.1 Upper Adjust Control

Sets output of the module current supply.

2.3.2 Lower Adjust Control

Sets output of module voltage supply

2.3.3 Upper Meter

Reads current in the range selected by the current range switch, (black markings on the module).

2.3.4 Lower Meter

Reads voltage in range selected by the voltage range switch, (red markings on the module).

2.3.5 Power Switch, Test Switch, Indicator Lamps

Operation is identical to that given in basic unit manual.

2.4 TEST CARD CONTROLS

The Test Card Control consists of a circuit resonance adjustment, which is labeled "TUNE" and a range switch covering a frequency range of 3MHz to 24 + MHz.

2.5 INTERCONNECTIONS

2.5.1 Attenuator In

this is a BNC RF Connector jack which is connected to the input of the built in attenuator.

2.5.2 Attenuator Out

This is a BNC RF Connector jack which is connected to the output of the built in attenuator.

2.5.3 Test Card Connections

2.5.3.1 Test Signal

This is a BNC type RF connector which is connected to the input circuit of the device under test.

2.6 MEASUREMENT PROCEDURE

2.6.1 Calibration to the Signal Generator

A transistor with unity gain is simulated by plugging a short #22 AWG bare wire between the "B" and "C" pins at the test socket.

Set both of the attenuator switches to "off". Set the main power switch on the Model 70 frame to "on", but do not depress the test switch. Wait until the BETA meter settles down and then adjust to zero with the "ZERO" control on the 10 RF-1 panel.

Connect the generator, the attenuator, and the test card as shown by Fig. 2-1. Use the short cable supplied by the factory for the connection between the attenuator and the test card.

From a 50 ohm source and via a 50 ohm cable apply approximately 1V RMS* signal to the attenuator input jack. Adjust the "TUNE" control on the test card for maximum deflection of the BETA meter. Ascertain that the tuning control is not at either extreme. If so, select a more appropriate frequency range position and return. Next set the signal level at the generator until the BETA meter reads 1. The generator is now calibrated. Remove the wire jumper from the test socket.

*3	- 6 MHz	approximately 1V RMS
6	- 12 MHz	approximately 700 MV
12	- 24 MHz	approximately 500 MV
24	-	approximately 500 MV

2.6.2 BETA Measurement

Having completed ~~one of~~ the calibration procedures of section 2.6.1, set the polarity switch to NPN or PNP as required by the transistor to be tested. Set the emitter current and collector voltage range switches to the desired ranges, but set the main frame adjust controls full CCW. Insert the device to be tested. Depress the "TEST" Switch and advance the adjust controls until the desired DC operating conditions are obtained. Adjust the "TUNE" control on the test card until maximum deflection of the BETA meter is obtained, taking care that a true resonance is obtained. (See section 3.10.3) If the BETA meter reading exceeds full scale insert 10DB of attenuation. "10 DB" switch "on", "20 DB" switch "off". The full scale calibration is now 10 instead of 3. Settings for the various ranges are marked on the front panel.

2.6.3. F_t Measurements

It is quite possible to obtain F_t with the 10 RF-1 even though F_t may be above the range of the instrument. BETA measurements at two frequencies an octave part may be extrapolated to approximate the frequency where BETA is unity.

SECTION 3

CIRCUIT DESCRIPTION

3.1 BLOCK DIAGRAM

Figure 3-1 illustrates the circuitry of the total 10RF-1 in block form.

Refer also to overall schematic, Figure 3-2.

3.2 VOLTAGE SUPPLY

The secondary of T103 in the basic unit supplies AC voltage for bridge rectifier D202. The taps of T103 are selected by voltage range switch S202. Filtering is performed by L201, C207A, and C207B. Capacitors C207 and C208 are switched in by S202D-6 and 12 voltages for better filtering; there is higher current demand at lower voltages.

S202, B-6 selects the appropriate multiplier resistors required to set the collector voltmeter range in synchronization with the voltage tap selection by S2024-12 and S202D-12.

3.3 CURRENT SUPPLY

DC for the emitter current supply control is provided by D104, D103, C103 and C103 from one secondary of T102 in the basic unit. Q201 is a variable divider with control of the base voltage. The variable base voltage is supplied by a divider composed of R203 and R103, the upper adjust control in the basic unit. Since the emitter to base voltage drop is very small over a wide range of emitter to collector currents, the voltage from the emitter of Q201 will follow the Q201 base voltage very closely. Since this current supply is used with a series resistor, the voltage from current supply is equalized by the drop in the resistor, leaving only the current component from the circuit. The open-circuit voltage at the Test Card connector pins is zero to approximately 12 volts maximum. A minimum of 10 ohms series resistance should always be used with this supply.

D201, C201 and R202 supply a slight positive voltage to the emitter of Q201 to offset the slight voltage drop of base to emitter in Q201 when the base voltage is zero.

3.4 TEST CONTROL AND OVERLOAD SENSING

Relay K201 is closed whenever the test switch is in the actuated position.

3.4 TEST CONTROL AND OVERLOAD SENSING (Cont'd.)

The overlaod sense line, Pin 14 of the module connector, must have from 4 to 5.5 volts positive in relation to Pin 13 to trip the overload and drop out K201. The trip voltage sensitivity is increased by floating the in-module sense return via the driver formed by R201. In the standard setting, R201 is adjusted for a 3 volt drop between its arm and the end toward Pin 13 of the module connector.

Sensing of overloads is done by connecting the sense lines across voltage-dropping resistors, R217 to R212 with S201-F.

3.5 CURRENT METERS

The emitter current meter is contained in the module and is the upper meter in the basic unit. Current meters have shunts arranged for a 125 millivolt drop at full-scale.

D105 through R239 are the shunts for the emitter current meter. D205 is a protective diode for guarding against back currents.

R253 is a calibrate control which compensates for the variation of internal resistance between meters.

3.6 CURRENT-LIMITING RESISTOR NETWORKS

The resistor group R206 through R211 is interconnected in series with the current supply return line to provide a constant voltage source. S201-E selects the resistor and the current range. Since the maximum voltage out of the current supply for any range is 10 volts, the resistor is selected for a 10 volt drop maximum with the particular range selected.

3.7 THEORY OF OPERATION

3.7.1 RF Measurement

The 10RF-1 is designed to measure the small signal current transfer ratio, H_{fe}, at radio frequencies from 3 MHz to 30 MHz. The measurement is made with the device connected in the grounded base configuration for the DC bias voltages and in the grounded emitter configuration for RF signal voltages. Refer to the simplified schematic, Fig. 3-3.

For accurate current gain measurements, the following conditions should be satisfied by the test circuit. These are as follows:

3.7.1.1 The AC load at the collector must be as small as practicable, ideally approaching a short circuit. If the load is too high compared to the dynamic resistance of the device (r_c) the current in the collector circuit will be limited by the load

3.7.1.1 (Cont'd.) resistance. The load resistance will display no measureable effect if it is maintained at less than 1/1000 of r_c. In the 10RF-1 which used a 10 ohm load, the device r_c value may be as low as 10,000 ohms.

3.7.1.2 The signal level shall be no more than 10% of the DC bias voltages or currents. For the worst case low gain device in the 10RF-1 the base current is 100 microamp and the collector current will be up to 300 microamp.

3.7.1.3 Base current into the device should be constant and non-reactive. This is accomplished by driving the base from a 50 ohm source in series with a 10K ohm non-reactive resistor and with a parallel tuned circuit at the base. The tuned circuit cancels reactive currents flowing into device and circuit capacities.

3.7.1.4 The grounded emitter voltage gain should be kept small. Otherwise the capacity multiplication (Miller effect) resulting from excessive voltage gain will make the circuit difficult and confusing to tune. Voltage gain should be unity if r_c is 100,000 ohms or more. If r_c should be as low as 10,000 ohms the voltage gain will be approximately 8.

The measurement process is extremely simple. With no device in the circuit a known signal from a constant current source is applied to the load resistor, detected and the output level noted. Next a device is inserted and the same, or known proportion of calibrated signal is applied to the base. The signal current at the collector of the device will be the result of the current transfer through the transistor. If the device has gain the detector output indication will be proportionally greater. RF BETA then will be the ratio between the two readings and is is quite feasible to calibrate the meter to read BETA directly.

3.7.2 The meter amplifier receives a minute DC voltage and the detector diodes amplifies this signal sufficiently to drive a 50 microampere DC meter movement. Monolithic integrated amplifiers are used.

Amplifier A1 is connected in the inverting mode and A2 in the non-inverting configuration, each state with its own feedback loop. In addition there is an overall feedback loop from the output of A2 back to A1. This helps to correct for the voltage offset drift at A2. A1 is encased within a positive coefficient silicon oven with a thermal gain of 10. After an initial warm-up the instrument is

3.7.2 (Cont'd.) stable over a wide ambient temperature range. About one minute after turn on the instrument may be set to zero by the zero control on the module panel.

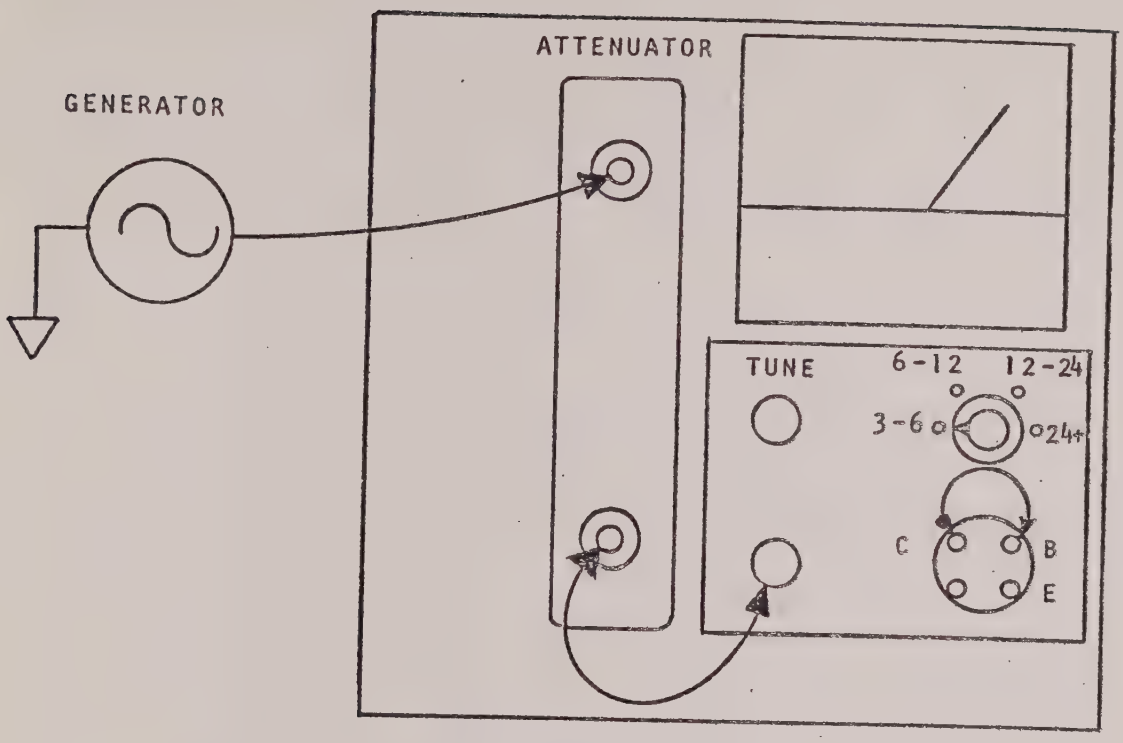


FIG 2-1
CALIBRATION

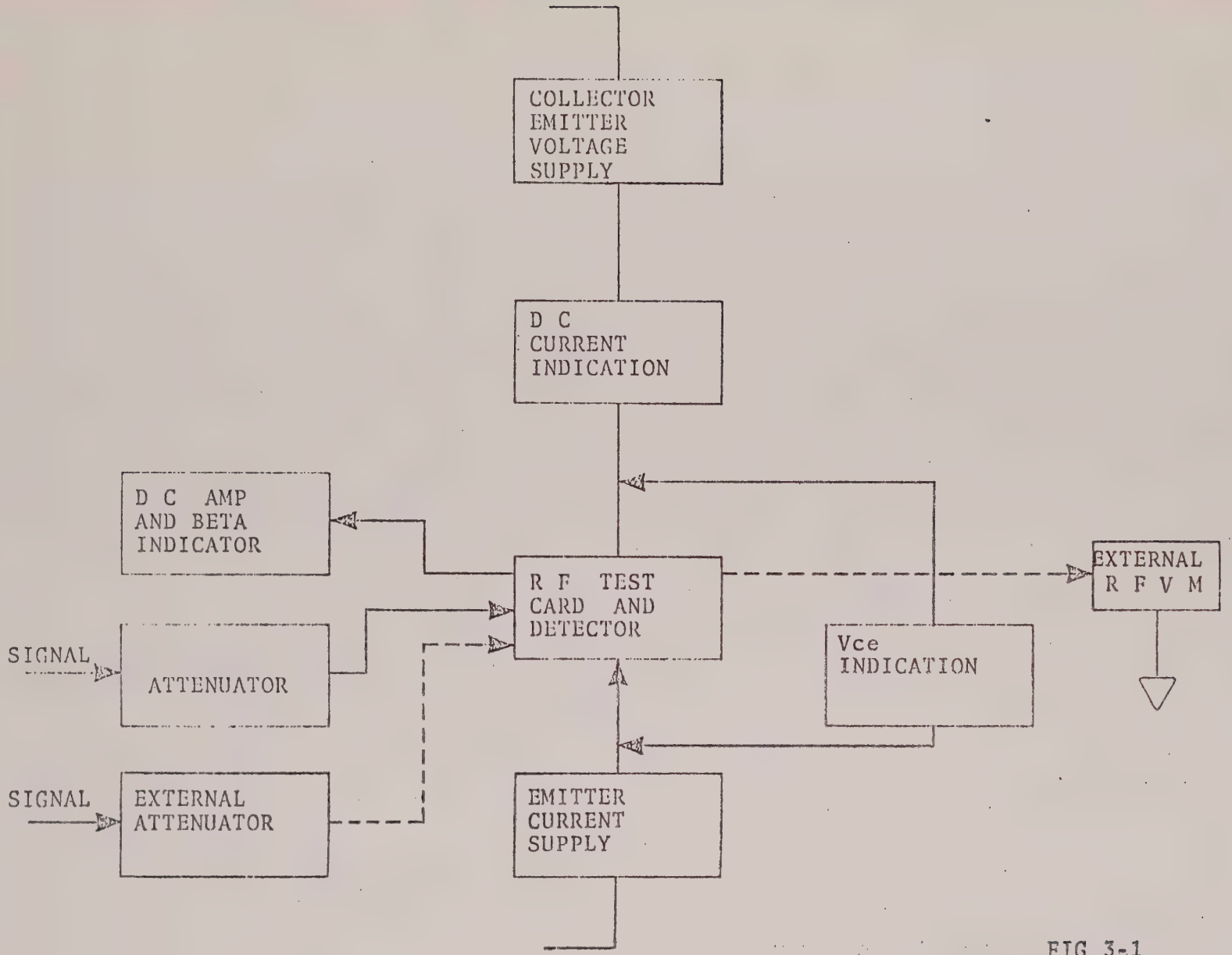


FIG 3-1
BLOCK DIAGRAM

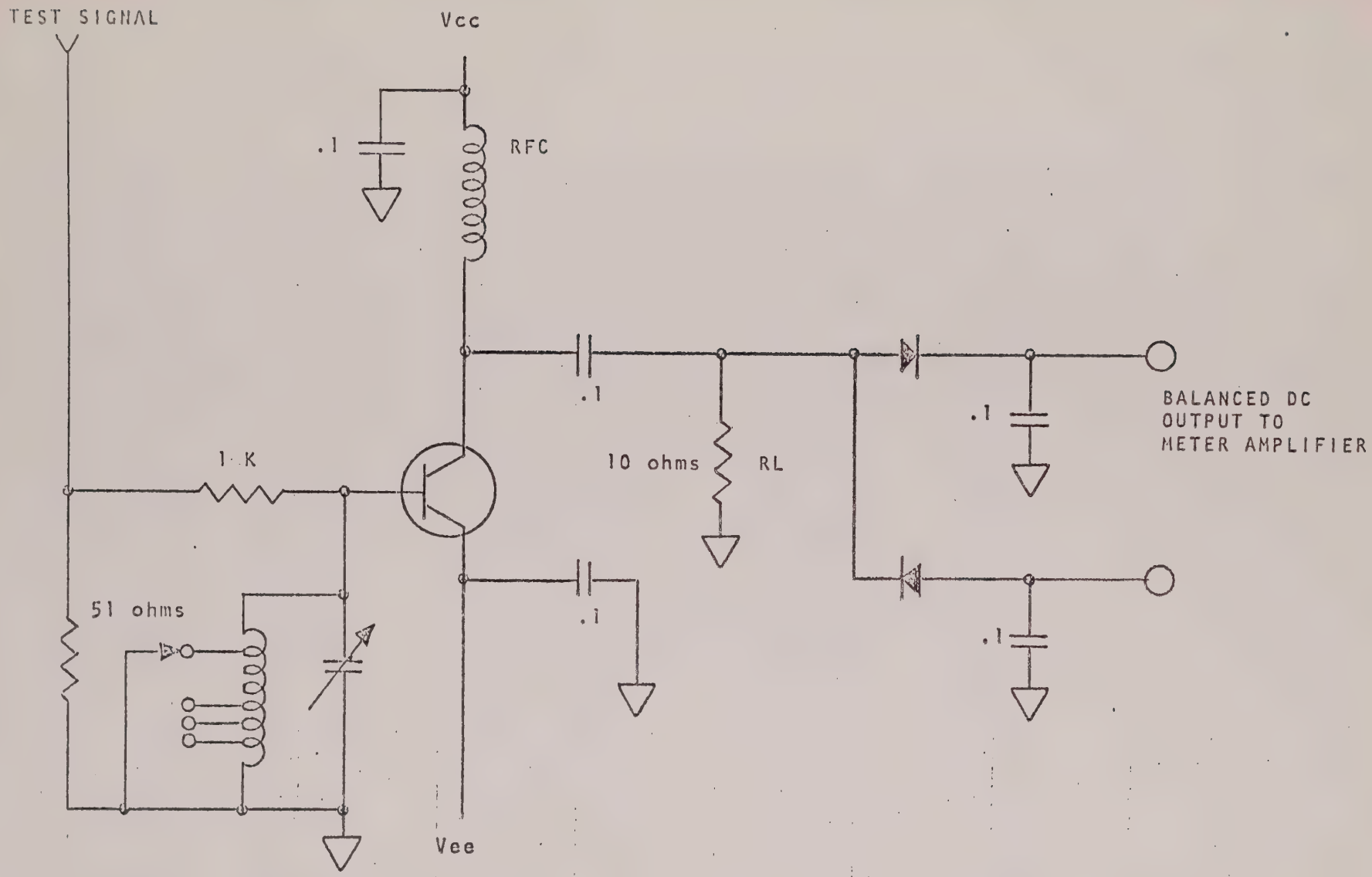


FIG 3-3
RF-1 MEASUREMENT CIRCUIT

SECTION 4

MAINTENANCE

4.1 REPLACEMENT PARTS

4.1.1 Standard Components

Precision Standards Corporation will supply replacement components that may be required. However, since most of the components are standard electronic and radio parts, you may obtain them locally if you desire.

4.1.2 Selected Components

We specially select some of the components whose values must fall within prescribed limits. By sorting through our regular stocks, the components so selected will have standard RETMA color coding showing the value and tolerance of the stock from which they were selected; but they will not, in general, be replaceable from dealer stock.

4.1.3 Precision Standards Manufactured Parts

Precision Standards Corporation manufactures almost all of the mechanical parts and some of the components used in the instrument. If you order a mechanical part, be sure to describe the part completely to prevent any unnecessary delay in filling your order. When you have any questions about mechanical parts or Precision Standards components, contact our nearest field sales representative or write to the Customer Service Department at the factory in Santa Ana, California.

4.2 REMOVAL AND REPLACEMENT OF PARTS

The procedures required for replacement of most parts in the Type 10RF-1 are obvious. Detailed instructions for their removal are not required. Other parts, however, can be best removed if a definite procedure is followed. Instructions for the removal of some of these parts are contained in the following paragraphs.

4.2.1 Replacement of Switches

Methods of removal of defective switches are, for the most part, obvious and only a normal amount of care is required. Single wafers are normally not replaced on the switches used in the Type 10RF-1; and if one wafer is defective, the entire switch should be replaced. Switches may be ordered from Precision Standards Corporation, either wired or unwired, as desired.

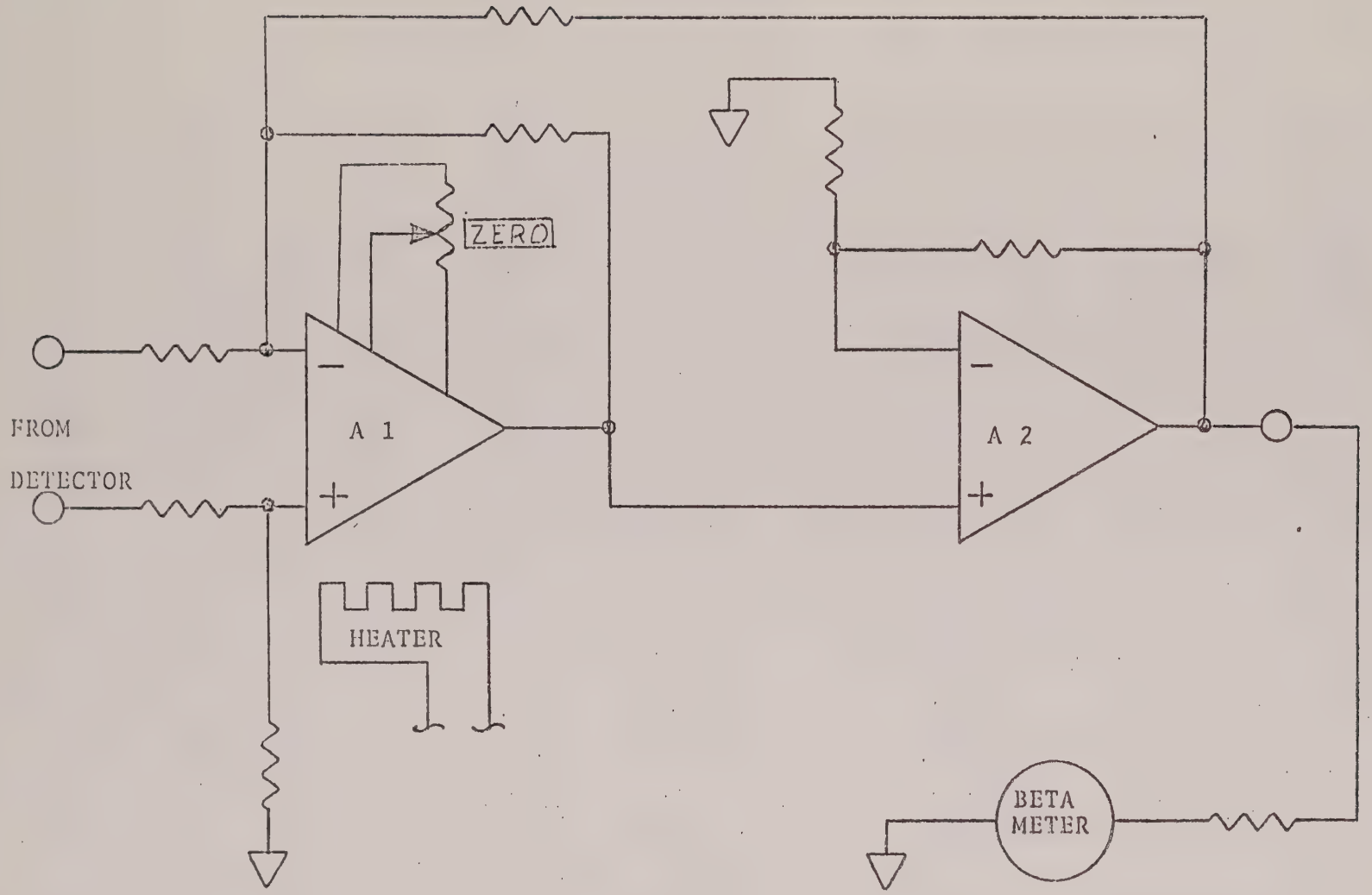


FIG 3-4
METER AMPLIFIER
SIMPLIFIED SCHEMATIC

4.2.2 Replacement of PC Board Components

Some components in the program cards are mounted on a printed circuit board. To avoid damage to the PC board when replacing components, the following precautions should be observed:

Use a low power soldering iron (50 watts maximum).

Use only a high quality rosin core solder, NEVER A PASTE FLUX. After soldering, clean off any excess flux.

When replacing components with multiple mounting pins, such as tube sockets, transistors, potentiometers, etc., it will be necessary to lift each pin slightly, working around the component several times until it is free. The test card diodes are especially easy to damage by soldering operation.

CAUTION: Do not change the position of parts on the Test Card.

4.3 CALIBRATION

The Type 10RF-1 Test Module is a stable instrument and should not require frequent calibration. However, it will be necessary to calibrate certain parts of the instrument when components are changed. Also, a periodic calibration is desirable from the standpoint of preventative maintenance.

In the instructions that follow, the steps are arranged in the proper sequence for full calibration. Each numbered step contains the information necessary to make one adjustment. If a complete calibration is not necessary you may perform individual steps.

4.3.1 Test Equipment

The following equipment is necessary for a complete calibration of the 10RF-1 Module:

4.3.1.1 DC Voltmeter of $\pm$ 1/2% accuracy or better to read 1.00 to 100 volts with a resistive impedance of 100,000 ohms per volt or greater.

4.3.1.2 DC ammeter to read 3 ma, 10ma, 30ma, 100 ma, 300 ma and 1 ampere accuracy of $\pm$ 1/2% or better.

4.3.1.3 Test Card #1 or #2 for the 10 RF-1

4.3.1.4 Precision Standards Type B5536 Module Extender Cable (not necessary, but helpful).

4.3.2 Preliminary Set-Up

4.3.2.1 If the Module Extender Cable is not available, remove the cabinet from the basic unit and then install the 10RF-1 and the basic unit together with the extender.

4.3.2.2 Insert a BETA Test Card

4.3.3 DC Meter Calibration

Calibration shall be accomplished in sequence as follows:

4.3.3.1 Voltmeter Calibration

Plug in Test Card #3. Connect a standard voltmeter between pins C and E at the test socket. With a polarity switch at NPN the positive terminal of the standard meter is to be connected to the "C" pin at the test socket.

Set the voltage adjust control on the main frame to approximately mid scale. Turn on the main power switch and then hold down the test switch. Compare the reading of the standard meter with the meter reading on the main frame. This procedure will be followed for each of the five voltage ranges. i.e. with the collector voltage range switch set to 1, 3, 10, 30, and 100 volts.

4.3.3.2. Emitter Current Calibration

With Test Card #2 in place, and power OFF, connect a 1 ohm 1 watt standard resistor between the C and the E Terminals (in series with a standard ammeter) as shown by Fig. 4-1.

Set the collector voltage range to 1 volt and both of the adjust controls fully CCW. Set the current range switch to one amp. Press the TEST switch emitter and advance the upper and lower adjust controls. Compare the readings of the standard ammeter with the emitter current meter on the Model 70 frame.

Repeat this procedure with the following settings:

COLLECTOR VOLTAGE RANGE	EMITTER CURRENT RANGE	CALIBRATION RESISTOR
3 V	300 Ma	3.3 Ohm
3 V	100 Ma	33 Ohm
10 V	30 Ma	330 Ohm
10 V	10 Ma	1000 Ohm
10 V	3 Ma	3300 Ohm

4.3.4 Overlaod Protection Trip Voltage

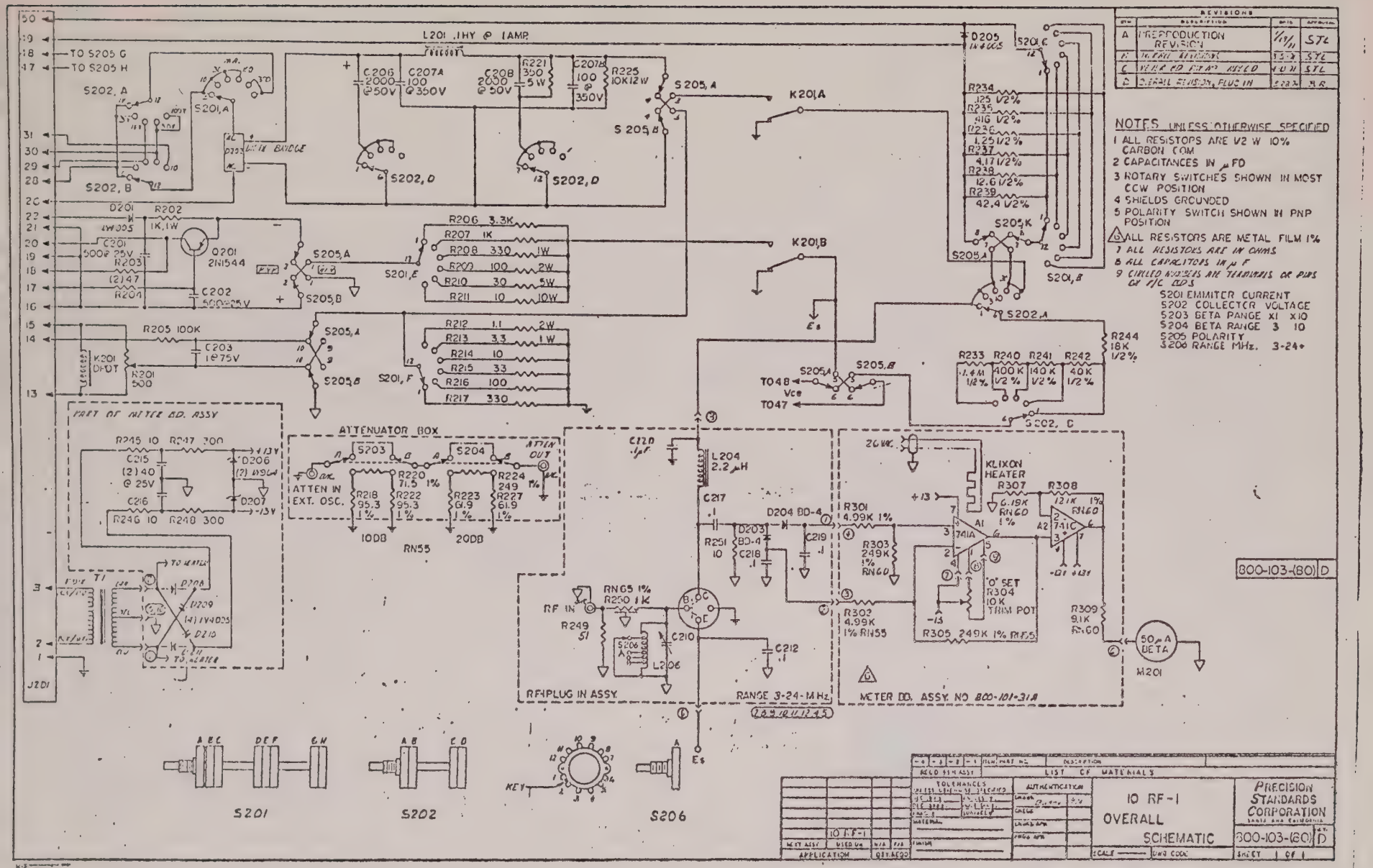
4.3.4.1 The trip voltage for the overload sense line may be set either of two ways: The standard setting for commonality with all basic units and a sensitive setting for special tests. The sensitive setting will vary when the same module is used with different basic units.

4.3.4.2 The standard setting consists of attaching an external DC Voltmeter to the R201 terminals, positive to the slider and negative to the CCW terminal of R201. The card is removed and the test switch set to test. R201 is then adjusted for an indicated 3 volts on the external voltmeter. The overload circuit will now trip at between 1 and 2 1/2 volts on the sense line.

4.3.4.4 The sensitive setting can be adjusted easily by calculating the required voltage for tripping applying this voltage from an external supply to card connector Pins 9 and 10, and the adjusting R201 so that the overload trips.

4.3.5 Switch-Selected Resistor Networks

The resistor groups switched by S201, S202 and S203 should remain in tolerance throughout the life of the instrument. The values may be checked readily with a resistance bridge connected to either the module or card connector or directly in the module circuit. This check can be done with the module withdrawn from the basic unit with no power applied.



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	PRE-PRODUCTION REVISION	1/11/11	STL
B	ALL FINAL ASSEMBLY	3-3-71	STL
C	WIRE TO FIT AS NEED	4-9-71	STL
D	OVERALL REVISION, PLUG IN	5-28-71	STL

NOTES UNLESS OTHERWISE SPECIFIED

1 ALL RESISTORS ARE 1/2 W 10% CARBON COM
2 CAPACITANCES IN µ FD
3 ROTARY SWITCHES SHOWN IN MOST CCW POSITION
4 SHIELDS GROUNDED
5 POLARITY SWITCH SHOWN IN PNP POSITION
6 ALL RESISTORS ARE METAL FILM 1%
7 ALL RESISTORS ARE IN OHMS
8 ALL CAPACITORS IN µ F
9 CIRCLED NUMBERS ARE TERMINALS OR PINS ON P/C CARDS

S201 EMMITER CURRENT
S202 COLLECTOR VOLTAGE
S203 BETA RANGE X1 X10
S204 BETA RANGE 3 10
S205 POLARITY
S206 RANGE MHz. 3-24+

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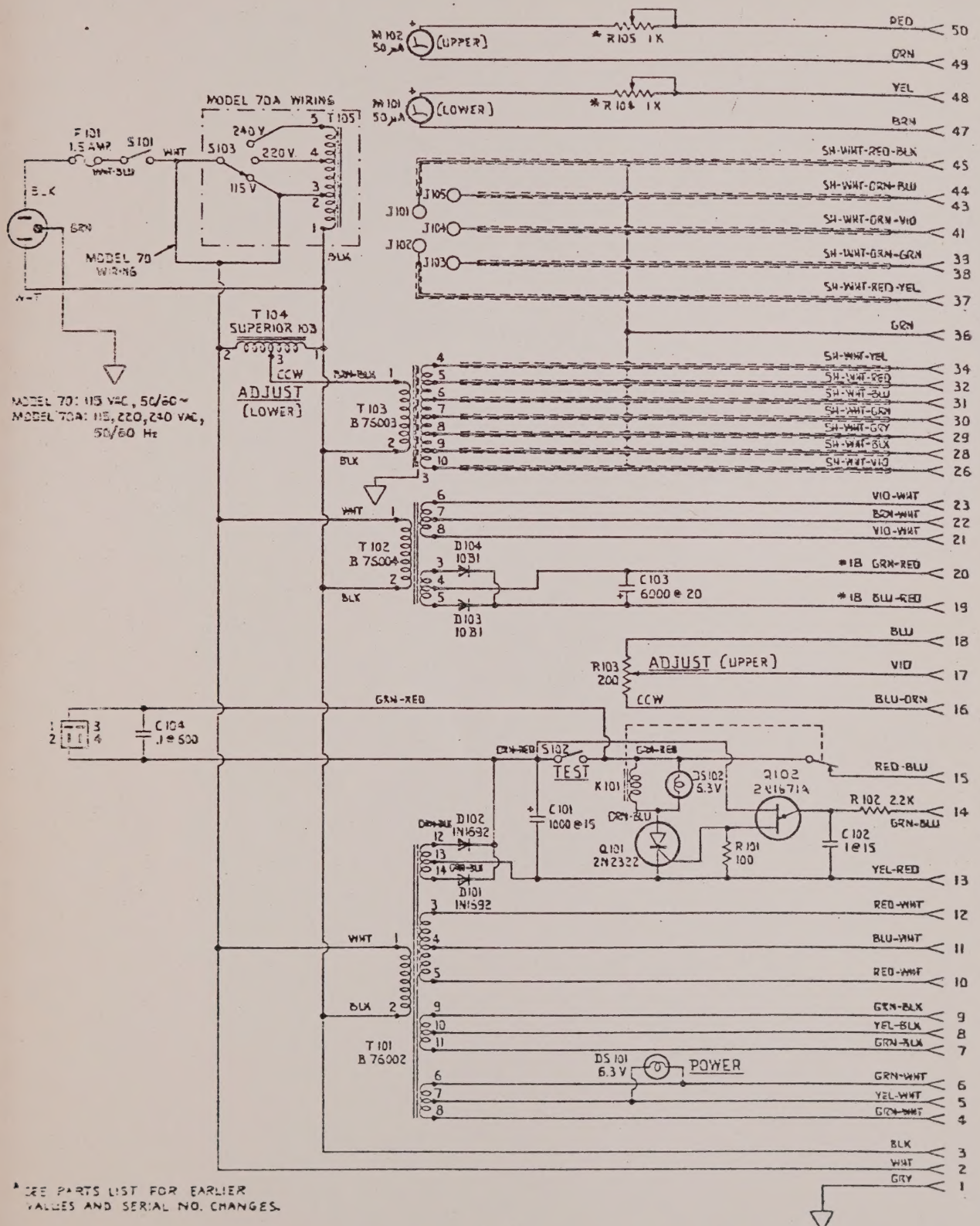


*SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NO. CHANGES.

REV. G

1. RESISTANCES IN OHMS
2. UNDERLINED CONTROL DESIGNATIONS APPEAR ON FRONT PANEL
3. CAPACITANCES IN μfd
   RESISTORS, ½W, ±10%, CARBON
4. UNLESS OTHERWISE SPECIFIED

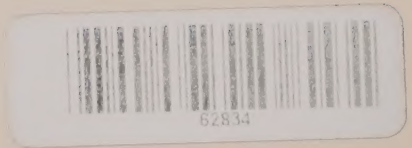
REV	DESCRIPTION	DATE	DWN	APPD
G	REVERSE LINE CORD CONNECTIONS & DWG. NUMBER ADDED	12-2-68	EB	
F	R104, R105 WERE 500Ω, WIRE COLORS ADDED	5-20-65	LHA	RM
E	REDRAWN	2-10-65	E.B.	

REVISIONS

BIRTCHER CORPORATION — INSTRUMENT DIVISION

MODEL 70 & 70A
SEMICONDUCTOR TEST SET
SCHEMATIC

DRAWN: E. Bateman — DATE: 2-10-'65
APP'D: R. Mack — DATE: 5-20-'65
DWG. C 1480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